cc: Cook/Hoffman 6-30-93

United States Department of the Interior

FISH AND WILDLIFE SERVICE
75 Spring Street, S.W.
Atlanta, Georgia
30303

JUN 22 1993

Memorandum

To: Don Orr, WHM, RW, FWS, Memphis, Tennessee

From: Chuck Hunter, Nongame Specialist, ES, FWS, Atlanta, Georgia

Subject: Lower Hatchie NWR Draft Forest Management Plan

Sorry it has taken so long for me to review the subject plan. I kept getting shoved off into other arenas and I had the impression that you were not in a hurry. Actually, David Smith and I spoke about a month ago on getting together to discuss the plan. We never did, however. His passing away has been a shock to all of us. He was instrumental from the first day we met in making me feel welcome in bringing my sometimes in left-field ideas on *nongame* to the table to discuss forestry on refuges. He also allowed for easing the suspicions of field staff that I was not there to disrupt their on-going efforts. Much of my understanding of forestry and fire issues on refuges I owe to him. Needless to say I am going to miss him deeply.

I have now finished my review of the Draft Plan and have only a few general comments. The draft plan overall is well done compared to many other drafts I have reviewed, from the nongame perspective. I still have a concern about an overriding interest in red oak regeneration. However, that is the recognized objective for many refuges in the lower Mississippi Valley and I do not have strong evidence to suggest that this is not a good objective for both game and some nongame species. Actually, I was surprised to see an emphasis on favoring some tree species (e.g., sweetgum and overcup oak) not usually favored in refuge forest plans, both of these species (and I would add mature cottonwood) have high nongame value as perhaps do any number of tree species not mentioned.

I was especially impressed with the rationale used in the Forest Openings Management section. I see no utility for permanent food plots and much potential harm to breeding nongame birds in a landscape dominated by agriculture. The use of regeneration sites and other imposed openings (i.e., roads, right-a-ways) should more

than satisfy the needs of species dependent upon or use early-successional habitats. This rationale was refreshing. Other comments are written on the attached pages from the Draft Plan.

Thank you again for asking for my review. I will try to get future requests filled in a more timely manner from now on.

Attachment

Don Orr's Comments 6-25-93

File Copy

2nd Set of Comments

LOWER HATCHIE

FOREST HABITAT MANAGEMENT PLAN

Prepared By

Robert W. LaFleur

and

Leif A. Karnuth

Foresters

United States Department of the Interior

Fish and Wildlife Service

Approved by:	Randy Cook	Refuge Manager	6-16-93 (Date)
Approved by:	Clyde A. Stewart	District Forester	6-16-93 (Date)
Approved by:		District Biologist	(Date)
Approved by:		Regional Forester	(Date)
Approved by:		Associate Manager	(Date)
Approved by:		ARD-Refuges & Wildlife	(Date)

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Part I. PROGRAM RELATION TO REFUGE OBJECTIVES

A. Preface

The Department of the Interior, being the nation's principle conservation agency, has the responsibility for managing the nation's forest, wildlife, water, fish, mineral, park and recreational resources, and historical sites.

The U.S. Fish and Wildlife Service (FWS) is responsible for managing renewable natural resources on National Wildlife Refuges. In its administration of the National Wildlife Refuge System (NWRS), the FWS is responsible for restoration, preservation, and management of wildlife and wildlands to maximize the benefits derived from these resources.

Refuge forest management programs in the Southeast have received considerable recognition from others who are interested in forest and wildlife management. Sound silvicultural practices are used to assure that the forest resource provides optimum wildlife habitat and creates a favorable environment where wildlife-oriented public use will be encouraged.

B. History

Lower Hatchie National Wildlife Refuge was established in 1980 by the Migratory Bird Conservation Commission. The refuge currently encompasses 7536 acres. The approved acquisition involves 8,600 acres lying along the Hatchie River in Lauderdale and Tipton Counties from about 12 miles west of the town of Henning to its confluence with the Mississippi River. The acquisition boundary encompasses the bulk of the remaining bottomland hardwood forest west of Highway 51 along the Scenic Hatchie River.

Land types include approximately 5,246 acres of forest, 1,233 acres of cropland, 65 acres of open lakes. The remaining 992 acres are a mixture of open land, sparsely forested ridges, and abandoned fields.

C. Refuge Objectives

National wildlife refuges are established to provide, preserve, restore, and manage a national network of lands and waters sufficient in size, diversity and location to meet society's needs for areas where the widest possible spectrum of benefits associated with wildlife and wildlands is enhanced and made available.

The Refuge Manual 6 RM 3.3 states "The primary objective of forest management on refuges is to develop, manage and perpetuate the diversity of indigenous wildlife populations needed to meet the refuge objectives."

Objectives of the NWRS forest management program listed in the Refuge Manual 6 RM 3.3 are:

1. To provide habitat and protection for those species of plants and animals indigenous to the refuge that are officially listed by the Service or States as being threatened or endangered.

The Refuge Manual 6 RM 3.3 states "The primary objective of forest management on refuges is to develop, manage and perpetuate the diversity of indigenous wildlife populations needed to meet the refuge objectives."

Objectives of the NWRS forest management program listed in the Refuge Manual 6 RM 3.3 are:

1. To provide habitat and protection for those species of plants and animals indigenous to the refuge that are officially listed by the Service or States as being threatened or endangered.

2. To provide habitat for waterfowl and other wildlife species.

3. To provide compatible opportunities for wildlife-oriented recreation, environmental education, and interpretive/demonstration activities.

Lower Hatchie NWR was specifically authorized for use as an inviolate sanctuary, or for any other management purpose, for migratory birds; and for incidental fish and wildlife-oriented recreational development, the protection of natural resources, and the conservation of endangered species or threatened species.

Specific objectives of the forest management program at Lower Hatchie NWR are:

1. Identify and promote critical habitat for threatened or endangered species.

2. Maintain a variety of plant species needed for wintering waterfowl and other migratory birds.

3. Providing den and snag trees to meet the needs of a wide variety of wildlife species.

4. Promoting a high red oak component within timber stands that are capable of sustaining the red oak species.

D. Obtaining Refuge Objectives

Lower Hatchie NWR objectives will be met by:

1. Managing the forest to maintain and enhance necessary habitat for threatened and endangered species, by promoting plant communities beneficial to these species.

2. Managing timber stands to enhance waterfowl habitat, by manipulating stand composition in order to produce high quality food and to provide adequate nesting areas. This will include promoting red oak and other favored tree species and by assuring that adequate den and snag trees remain in the stands.

3. Manipulation of forest stands to provide diverse habitat for a wide variety of wildlife species present throughout the refuge, by providing a variety of plant successional stages ranging from regeneration to mature timber.

2. Managing timber stands to enhance waterfowl habitat, by manipulating stand composition in order to produce high quality food and to provide adequate nesting areas. This will include promoting red oak and other favored tree species and by assuring that adequate den and snag trees remain in the stands.

3. Manipulation of forest stands to provide diverse habitat for a wide variety of wildlife species present throughout the refuge, by providing a variety of plant successional stages ranging from regeneration to mature timber.

4. Performing management actions that will compliment recreational and educational activities, by carefully planning when and where management actions should take place.

5. Utilizing management techniques which do not adversely effect soils, water bodies, or any other natural resources present. These techniques should include harvesting under proper climatic conditions and placing buffer strips where necessary to protect water quality or other natural resources.

E. Wildlife Species to be Favored

Management of the refuge forest habitat will be directed primarily by the habitat requirements of:

Endangered Species
Migratory Birds

Exhibit 4 lists the resident and migratory birds which have been sighted on the refuge and those which are believed to visit the refuge. Ideal habitat conditions are outlined in this section. These recommendations will be used for guidance, and may supersede ideal silvicultural treatments.

1. Endangered Species

At this time there are no threatened or endangered species using the refuge. Care will be taken to identify any species which may move into the refuge or any species currently using the refuge which may be listed threatened or endangered in the future.

2. Migratory Birds

Migratory birds, including waterfowl, will receive special emphasis at Lower Hatchie refuge. The

geographic location of this refuge and the variety of habitat types provided enable this refuge to meet breeding, migration and wintering habitat needs for numerous species of migratory birds as well as many other wildlife species. The area is particularly favorable to wetland wildlife species since most of the habitat is wetland.

a. Waterfowl. Wood ducks are the most common cavity-nesting waterfowl in North America (Bellrose 1978 ~~1980~~). Wood duck populations are, therefore, impacted by the status of forested wetlands. Since over 80 percent of the forest in the Lower Mississippi River Delta has been cleared, how the remaining 20 percent is managed can influence wood duck populations. Until recent years it was generally thought that the number of cavities in refuge forests were adequate to meet wildlife needs. In 1989 Lowney and Hill found that only 15 of 107 (14%) natural cavities were suitable for use by wood ducks on Noxubee Refuge in Mississippi.

An inadequate number of suitable nesting cavities can be an important limiting factor for wood duck populations. Cavities with an entrance size of ≥3.5 inches, an interior basal area of ≥40 square inches and height ≥6 feet above the ground are preferred nesting sites of wood ducks (Dugger and Fredrickson 1992). Trees that are ≥12 inches in diameter at breast height produce most of the suitable nesting cavities. Important cavity-tree species in the Lower Hatchie area are beech, sycamore, water oak, overcup oak, slippery elm, black willow, bald cypress, black gum, ash, maple, tupelo gum and cottonwood.

Initial movements from the nest site by female wood ducks and their broods can be up to 2.4 miles but average 0.8 mile (Dugger and Fredrickson 1992). Hens seek out shallowly-flooded habitat with overhanging vegetation or emergent vegetation to raise their broods. Proper management of such brood areas will be a component of the overall forest management program at Lower Hatchie. Beaver ponds normally provide excellent wood duck brood habitat. Although some beaver control may be necessary, having up to 10 percent of the forested area in beaver ponds may be desirable. Such wetlands are important wood duck brooding and roosting areas and can be very important to

wintering waterfowl when natural flooding is limited.

The objective for wood duck cavities at Lower Hatchie will be to produce one suitable cavity per two acres of forested habitat. If we assume that only 15 percent of the cavities in a stand are suitable for wood ducks, then at least 4 cavities per acre are necessary to achieve the cavity objective. The forest management program will encourage maximum (at least 100 year) rotation age, retaining some large and overmature trees that are likely to produce cavities and always maintaining some areas (stands) of old-growth timber. A mix of tree species will be maintained in each stand so that both cavities and a variety

wintering waterfowl when natural flooding is limited.

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Acorns are the favored foods of more wood ducks in more places than any other plant food--from New Hampshire to South Carolina to Mississippi to Wisconsin (Bellrose 1978). During the winter,nearly 100 percent of the diet of wood ducks consists of plant foods, of which 75 percent may be acorns (Dugger and Fredrickson 1992). Although acorns are important to wood ducks, they also readily feed on other seeds, fruits and invertebrates that are produced in forested habitat. The forest habitat management strategy for food production will be to favor a high composition of oaks while maintaining a mix of other species that are also important food producers such as elm and maple. To increase or maintain a high density of oaks, which are not tolerant of shade, requires that a stand be essentially clear-cut near the end of the cutting cycle. These clear-cut areas should be at least 2.5, but not normally larger than 5, acres. Clearcutting is necessary to provide adequate light for young oak seedlings to become permanently established. Clearcut areas normally provide an abundant crop of annual seeds for up to three years. These seeds are important foods for waterfowl and many other species of migratory birds.

b. Other Migratory Birds. Numerous other species of migratory birds utilize the forest habitat at Lower Hatchie. Although an inventory list has not been compiled, over 200 species would be expected to occur in the bottomland habitat of this geographic area. Habitats utilized by these 200

species of migratory birds is highly variable and ranges from open fields to interior forest.

One important group of birds the forest management program will consider are the cavity-nesters. Scott et al. (1977) identified 25 species of non-waterfowl cavity-nesting birds that would be expected to occur in the Lower Hatchie geographic area. These birds excavate nesting holes, use cavities resulting from decay (natural cavities) or use holes created by other species in dead or deteriorating trees. Dead or deteriorating trees, frequently called snags, are not only important for the cavities they produce, but also for the insects they harbor. The majority of cavity-nesting birds as well as many other migratory birds feed exclusively on insects. Insect-eating birds can play an important role in controlling forest insect pests (Thomas et al. 1975). Information is not presently available on the number of snags needed per acre in bottomland hardwood habitat to support populations of cavity-nesting birds. The forest management strategy at Lower Hatchie will, therefore, be to maintain all snags.

In recent years populations of neotropical birds have declined significantly. Lower Hatchie is located in the East Gulf Coastal Plain physiographic region where 23 species of breeding neotropical birds are likely to occur in mature bottomland forests. A list of these 23 species (Table 1) is presently being prioritized and management recommendations formulated. Within the mature bottomland hardwood habitat type, some species occupy the understory, some the midstory and some the canopy (Exhibit 11). Presently, it seems a forest management program that focuses on maintaining mature stands of mixed bottomland hardwood timber would be the best course of action for breeding neotropical migrants. This will be the focus at Lower Hatchie plus there will be a 772 acre natural area and a 320 acre corridor along the Hatchie River in which no cutting will be permitted. The 4154 acres of managed timber will consist of mature timber, young stands and regeneration areas which will provide a diverse forest habitat. At least 60 percent of the forest habitat will be >50 years of age and 40 percent <50 years of age. This management strategy will provide a diversity of forest habitats for a wide variety of migratory birds.

F. Tree Species to be Favored

Some of the more desirable tree species to be favored due to mast production, denning, and nest potential are:

Nuttall Oak	-	Quercus nuttallii
Cherrybark Oak	-	Quercus falcata
Water Oak	-	Quercus nigra
Willow Oak	-	Quercus phellos
Overcup Oak	-	Quercus lyrata
Green Ash	-	Fraxinus pennsylvanica
Baldcypress	-	Taxodium distichum
American Elm	-	Ulmus americana
Sweetgum	-	Liquidambar styraciflua
Sweet Pecan	-	Carya illinoensis
Sycamore	-	Platanus occidentalis
Persimmon	-	Diospyros virginiana
Blackgum	-	Nyssa sylvatica
Dogwood	-	Cornus sp.
Holly	-	Ilex sp.
Black Cherry	-	Prunus serotina
Mulberry	-	Morus sp.
Beech	-	Fagus grandifolia

When making silvicultural decisions, these species should be favored due to their ability to enhance habitat, in order to meet refuge objectives. The goal is not to eradicate any species that may not be on this list, but to recognize the importance of these favored species and their need for special management consideration.

1. Forest Cover Types

The refuge has nine distinct cover types. These classifications are taken form the Society of American Foresters, "Forest Cover Types of the United States and Canada" booklet. Exhibit 9 describes each cover type. Refer to Table 1 for acreage by cover type by compartment.

Cover types include, 63-Cottonwood, 91-Swamp Chestnut Oak-Cherrybark Oak, 92-Sweetgum-Willow Oak, 93-Hackberry-American Elm-Green Ash, 94-Sycamore-Sweetgum-American Elm, 96-Overcup Oak-Water Hickory, 101-Baldcypress, 102-Baldcypress-Tupelo, 103-Water Tupelo-Swamp Tupelo.

Refer to Exhibits 19-25 for compartment maps and spatial distribution of cover types. The compartment maps also show size classes and stocking levels for the forest acreage. The size classes are sawtimber, pulpwood, and regeneration. Refer to Table 2 for

complete list of acreage by size class and density by compartment.

2. Silvicultural Treatments

~~In making~~ Silvicultural decisions will be based upon ~~we must keep in mind~~ the favored wildlife species and there habitat requirements as it relates to the favored tree species. Our goal is to promote the favored tree species which will meet the wildlife habitat requirements. ~~We must recognize~~ The importance of these tree species and the special management considerations which they must have ~~in order to~~ will assure that they remain a high percentage of the stand composition.

Silvicultural decisions should consider the age and vigor of the existing stands and the availability of desirable reproduction. ~~When harvesting~~ Timber ~~we~~ harvesting decisions will ~~must~~ be concerned with the promotion of young vigorous stands of timber, and not the production of fiber. Forest regeneration will be based upon ~~The forested acreage must be regenerated and must be done with~~ wildlife habitat requirements ~~as a driving force~~. decisions With this in mind, regenerating a maximum of one percent per year is recommended.

An important factor to consider when making silvlicultural decisions is the availability of advanced red oak reproduction (Refer to Exhibit 8). After reviewing the data collected and surveying the refuge there is great concern about the future of the red oak species on the refuge. Tables 4-8 clearly show the red oak component decreasing in abundance. Within stands which have a majority of red oaks in the dominant crown class the red oaks make up a very low part of the sapling and pole size class. Also, the majority of species found in the 4" to 12" size classes include shade tolerant species such as Hackberry, Maple, and Elm. Much of our time will be spent making cuts to aid the red oak reproduction and to promote it to an advanced stage so that it can be released by clearcutting. During the initial survey of the refuge, extensive data was collected concerning reproduction. This data was used to develop a reproduction densities map (Exhibit 17). These areas will receive high priority management attention. It is crucial that this reproduction be released to promote the growth of new stands with a relatively high red oak component.

Various silvicultural treatments will be used to promote favored timber species. These treatments

include, intermediate cuttings, timber stand improvement (TSI), shelterwood, and clearcut.

Intermediate cuttings will be used to reduce competition from non-favored shade tolerant species. These methods also provide additional growing space for favored species. They will promote a healthy stand of timber which will inhibit disease and pest infestations, and provide a good food source.

Timber stand improvement is the use of chemical or mechanical equipment to reduce the number of shade tolerant, less desirable species in order to benefit favored species reproduction. This will be necessary in areas where the less desirable species have taken over the understory and are preventing the favored species from competing successfully.

Shelterwood cuts are used to promote regeneration of favored species and to release this regeneration once it becomes advanced. Advanced regeneration is at least two to three years old and is healthy enough to survive after release. This method is done in a series of cuts, two or three. The first cut is preparatory. It is an improvement thinning in which the percentage of favored species remaining in the stand is increased by removing undesired species. This step may not be necessary due to intermediate cuttings which will be in practice throughout the refuge. The second cut is done by removing approximately 50 percent of crown cover. Once harvest is completed, about 50 percent of the ground surface area should be exposed to sunlight for several hours during the day. The basal area (BA) will be reduced to 50 to 60 square feet per acre. Favored tree species will be left and these trees should be in good health, in order to provide an adequate seed crop for reproduction. Once reproduction is sufficiently stocked, the seed trees will be removed to provide full sunlight for the growth of the new stand. This will be done using the clearcut method. It is critical that the red oak species which are being promoted receive full sunlight. These species are shade intolerant and cannot compete with the shade tolerant species, unless they are given full sunlight.

The clearcut method will be used when adequate desirable advanced regeneration is present and habitat conditions warrant the establishment of a new stand. These clearcut areas will range in size from two to five acres. Providing full sunlight is the key to the survival of the shade intolerant species.

G. Glossary

Basal Area - The area, usually expressed in square feet, of the cross section at breast height of a single or all trees in a stand.

Clearcut - A cutting which removes all trees for the purpose of releasing reproduction or preparing an area for artificial regeneration.

Compartment - An organizational unit or small subdivision of forest area for purposes of orientation, administration, and silvicultural operations. A compartment may contain one or more subcompartments.

DBH - Diameter of a tree trunk 4 1/2 feet above the base of the tree.

Endangered Species - An animal that may become extinct because of loss or damage of habitat and other adverse factors.

Entry Cycle - The period of years between two consecutive entries into a compartment. For the purposes of this plan, the interval will be 10 years.

Forest Cover Type - A vegetative forest cover type occupying a respective site or unit of ground.

Green-tree Reservoir - Areas of live timber artificially flooded during non-growing season to provide waterfowl habitat.

Habitat - The abode, natural or otherwise, of a plant or animal, considered particularly in relation to all environmental influences affecting it. A suitable habitat is one in which the organism can maintain itself and perpetuate the species.

Intermediate Cutting - Any removal of trees from a stand between the time of its formation and the regeneration cutting. Generally taken to include cleaning, thinning, liberation and improvement cutting, and sometimes salvage and sanitation cutting.

Intolerant - Shade Intolerant - The inability of a species to regenerate itself and grow in the shade of other trees.

Mast - The fruit and nuts of shrubs and trees.

Natural Regeneration - Natural establishment of a new crop of trees on an area by seed from trees left for that purpose or by hardwoods sprouting from existing roots.

Prescription - A plan written for a subcompartment before any work is started stating what is to be done and why the treatment is necessary.

Regenerate - The creation of a new stand by releasing reproduction or by artificial plantings.

Reproduction - The young tree crop itself, seedlings and saplings.

Rotation - The planned number of years between the regeneration of a crop of trees on an area and its final cutting at a specified stage of maturity.

Shelterwood - A series of silvicultural treatments designed to establish advanced regeneration of favorable species and then release this regeneration.

Silviculture - The science and art of cultivating (i.e., growing and tending) the forest.

Site Index - A particular measure of site class based on the height of the dominant trees in a stand at an arbitrarily chosen age.

Stand - A community of trees possessing sufficient uniformity in regard to species composition, age, and condition to be distinguished from adjacent communities.

Tally - The procedure of recording volumes of trees marked to be sold.

Threatened Wildlife Species - Species threatened with extinction because of loss of habitat or other factors.

Tolerant - Shade Tolerant - The ability of a tree species to regenerate and grow in the shade of other trees.

Part II. PROGRAM POLICIES AND ADMINISTRATIVE CONTROL

A. Fish and Wildlife Service Policy

Section 6 RM 3.2 of the FWS Refuge Manual states, "The policy of the Service is to manage forests in a manner that best meets the overall objectives of a particular refuge."

All forest management activities will be in accordance with the approved procedures, principles, and techniques stated in the Refuge Manual of the NWRS released March 12, 1982, or as amended.

B. Policy of Harvest

1. General

   The Conditions Applicable to Timber Harvesting Permits lists the general restrictions and regulations that apply to all logging operations.

2. Bottomland Hardwood

   Timber harvesting operations in these areas will be restricted to periods of sufficiently dry weather to prevent excessive soil disturbance and damage to the vegetation. Generally, the months of July through November are dry enough to permit logging in these sensitive areas. In some years the dry season is slightly longer, in others it may be very limited. In any case, the general weather and soil conditions at the time will dictate whether harvesting operations would be permitted.

   The types of equipment allowable in sale areas will be determined by the forester when marking the timber, and any restrictions will be stated in the bid invitation.

3. Conditions Applicable to Timber Harvesting Permits

   a. A pre-entry conference between the Refuge Forester and the designated Permittee representative will be a requirement before the purchaser starts logging operations. The purpose of the pre-entry conference is to be sure that the purchaser completely understands what is expected of him and thus avoid misunderstanding or serious conflicts.

b. If requested, satisfactory scale tickets for timber products shall be submitted to the Refuge Forester.

c. Bottomland hardwood species will be cut so as to leave a stump not more than 12 inches high for sawtimber. All stump heights are measured adjacent to the highest ground. In the case of swell-butted species or trees with metal objects in the butt, stumps may be higher.

d. Skidding is permitted only where designated on the sale map. The skidding of hardwood logs over 32 feet long may be prohibited in designated areas.

e. Ground level paint spot must remain visible after the tree has been cut. The logger may be required to cut all marked trees.

f. Trees and tops shall not be left hanging or supported by any other tree and shall be pulled down immediately after felling.

g. No traffic, including trucks, skidders, or any other vehicles, will be allowed to cross through any "Natural Area" adjacent to or near timber sale areas. "Natural Areas" close to timber sale areas will be indicated on the sale area map. Cutters should avoid felling trees into a "Natural Area" as much as possible. When a tree does fall into a "Natural Area," the entire tree will be pulled back into the sale area.

h. Tops and logging debris shall be pulled back 20 feet from public roads and lopped within 150 feet.

i. All roads, rights-of-way, fields, openings, streams, and firebreaks must be kept clear of tops and debris. Permittee shall also repair all damage to same resulting from operations conducted under this permit.

j. Littering in any manner is a violation of the Code of Federal Regulations. The entire work area shall be kept free of all litter at all times. Repairs and cleanup work will be accomplished to the satisfaction of the Refuge Forester.

k. The location of additional roads must be approved by the Refuge Forester. Additional trees removed for roads or loading sites will be paid for at bid

price. Unmarked trees which are cut or injured through carelessness shall be paid for at double the bid price.

l. Plugs, dams, and bridges constructed by the Permittee will be removed by the Permittee. There are areas on the refuge where temporary plugs or dams on an intermittent stream or ditch would not be allowable. Those areas will be indicated on sale area maps when necessary.

m. Loading of forest products on a public road, road shoulder, or regeneration area is prohibited.

n. Ownership of all products remaining on a sale area will revert to the Government upon termination of the permit.

o. The Refuge Forester shall have authority to temporarily close down all or any part of the operation during a period of high fire danger, wet ground conditions, or for any other reason deemed necessary. An equal amount of additional time will be granted to the Permittee.

p. The Government accepts no responsibility to provide right-of way over private lands for materials sold under this contract.

q. The Permittee and his employees will do all within their power to prevent and suppress forest fires.

r. The decision of the Refuge Manager shall be final in the interpretation of the regulations and provisions governing the sale, cutting, and removal of the timber covered by this permit.

s. When a timber sale area is adjacent to private land, all logging debris will be pulled back onto the refuge keeping damage to private property at a minimum.

C. Timber Marking and Thinning Procedures

Timber marking is the means ~~in~~ by which a forester designates a tree for harvest in order to improve wildlife habitat. Trees will be marked with two spots of paint, one at the base of the tree and one at eye level. Paint used should be vivid, of good quality and able to withstand degradation for two years.

All timber marking will follow sound silvicultural guidelines to achieve specific goals set forth in the prescription. Volumes will be calculated using the Doyle Log Rule for sawtimber and the Minor Equation for standard cord volume.

The purpose of thinning hardwood stands is to improve the health of the residual stands and to prepare the stand for future silvicultural treatments. Vigor, quality, species composition, and future silvicultural treatments should be considered when thinning is conducted.

The primary reason for forest management is to create, enhance, and maintain desirable wildlife habitat. Due to a lack of personnel, funding, and equipment, the Service does not have the expertise or the manpower to manipulate forest stands in order to improve wildlife habitat. Therefore one of the best management tools that we have to accomplish this is commercial timber sales. Maintaining a forest with commercial value is not the main objective of the forest habitat management program. However, it is extremely important that the forest acreage is managed in such a manner that surplus forest products maintain a commercial value if we are to achieve FWS objectives.

The guidelines listed below should be observed when marking timber. ~~these guidelines are basic silvicultural principles.~~ Some of these guidelines will be superseded by wildlife habitat requirements.

1. Generally den and snag trees will not be marked.
2. At least one large (≥ 12") tree per acre that is suppressed and/or will not survive until the next entry cycle will be left in the stand.
3. Non-favored tree species should be marked if they are encroaching upon favored species or to provide light for regeneration of favored species.
4. Poorly formed or defective trees should be marked to favor better quality trees, unless they are desirable for den or snag purposes.
5. Future silvicultural treatments that are needed to obtain wildlife objectives should dictate which trees to favor and the number of trees to be removed.

D. Policy and Administration of Sales

Guidelines for making timber sales are found in the Refuge Manual, sections 5 RM 17 and 6 RM 3, and they will be observed in all sales.

The preferred method of timber sales is the formal competitive sealed bid process with lump-sum payments prior to cutting. For large sales, marked areas will be divided into payment units and payment will be received when these areas are entered. For negotiated sales, the Refuge Forester shall make a reasonable effort to obtain at least 3 verbal bids to ensure the sale is competitive. The receipts from negotiated sales shall not exceed $2,500. Formal bid invitations will be mailed to all prospective buyers for all standard timber sales. The formal bid invitation will include:

1. A Timber Sale Formal Bid Invitation. See Exhibit 2.

2. A Bid Form which the bidder fills out and returns as his/her bid.

3. Detailed timber volume information. This information includes: tree species, average tree volumes, volume by species and diameter class, total number of trees marked, total acreage, and total sale volume.

4. A refuge map showing location of sale area.

5. A copy of conditions applicable to timber harvesting permit.

6. Certification of Independent Price Determination.

7. Equal Employment Opportunity Clause (Form 3-176).

The Refuge Forester will show the sale area to any interested party, by appointment. Perspective buyers will be allowed two weeks to cruise and inspect the timber for sale before the bids are opened. A specific date and time will be set for opening the bids. Late bids will not be accepted. If tie bids are received, new bid invitations will be sent out. Generally, the highest bidder will be awarded the contract, but the Government reserves the right to reject any or all bids.

All bidders are required to submit a performance guarantee bond deposit along with the Bid Form. The good faith deposit of the successful bidder is held as a performance guarantee deposit until satisfactory completion of the contract. The good faith deposits of

the unsuccessful bidders will be returned to them. The amount of the performance guarantee deposit will vary depending on the size of the sale; generally, it will not be less than $1,000 for small sales and will not exceed five percent of the appraised timber value for larger sales.

After selection of the successful bidder, a Bill for Collection (Form DI-1040) will be sent to the buyer for payment on the timber, which is due within ten days of the bid opening date and before any logging operations start. After payment is received, a Special Use Permit (Form 3-1383) will be issued to the buyer, thereafter referred to as the permittee.

The following documents will be sent to the FWS Finance Center: three copies of the Collection Transmittal (Form 3-2061), the pink copy of the Bill for Collection (Form DI-1040), the yellow copy of the Special Use Permit (Form 3-1383), one copy of the Timber Sale Formal Bid Invitation, the timber payment check, and the performance guarantee deposit check. All remittances are to be made payable to the U.S. Fish and Wildlife Service. Necessary information relative to all timber sales will be retained for future reference.

A Timber Sales Approval Authorization Form (Exhibit 3) must be completed on sales which exceed the Refuge Managers warrant authority, which is generally $5,000.

A copy of the Bid Invitation, the list of bidders receiving bid invitations, and the successful bidder's name must be mailed to the Small Business Administration (SBA) within 10 working days following the bid opening date. The mailing address is; United States Small Business Administration, 1720 Peachtree Rd. NW., Atlanta, GA 30367, ATTN: Robert Davis.

E. Sale Appraisal

Appraisal of forest products will be conducted by comparing existing markets as they relate to the volume, species, and quality of the timber offered, and by determining effects on this market by logging conditions and restrictions placed on the harvest operation. This appraisal will become part of the sale folder and will be used to assure the Service is receiving fair market value for the products removed.

F. Control Records

The purpose of records is to show progress made in fulfilling the plan objectives and to facilitate a accurate history of management actions. These records consist of: orders of entry plan and progress record, compartment map files, individual sale folders, and compartment prescription folders.
Compartment prescription folders will consist of: prescriptions, timber sale maps, stand maps, and a sheet listing each sale within the compartment showing date of sale, purchaser's name, and volume by species.

G. Compartment Prescription

A prescription is a plan that describes clearly the specific techniques and actions that will be applied to discrete blocks of forest habitat.

The development of a prescription should be a team effort between a forester and other professional habitat management personnel. The compartment will be jointly evaluated to decide what management actions are needed and which techniques will be used. After gathering the necessary field data, techniques should be used that ensure that all opportunities for improving habitat are utilized.

A prescription will contain the following information:

1. A detailed, written description of the existing forest types, including species composition, age, vigor, and density of the stands, disease or insect outbreaks, degradation of timber by other pests, site description, etc. Reference maps should be attached.

2. A description of habitat deficiencies as they relate to wildlife objectives.

3. A list of management actions needed and techniques recommended to achieve habitat modification, if needed. If commercially valuable forest products are scheduled for removal, this should be specified. Plans should address specific actions such as location and intensity of harvest; location and size of regeneration areas; road maintenance; prescribed burning; special measures desirable for endangered species, waterfowl, and other wildlife; aesthetics; and manpower and funding necessary to carry out the management program. Maps that reflect the proposed

treatments should be prepared. Treatments should be ranked in order of priority.

4. Written assurances that the appropriate supervision will be provided to check compliance with the provisions of any contracts awarded to implement management practices.

H. Natural Area

In forest habitat management it is customary that certain areas be designated as "No Management Zones." The primary objectives of the Natural areas or "No Management Zones" are:

1. To assure the preservation of a variety of significant areas for public use that, when considered together, illustrate the diversity of the refuge's natural environments.

2. To preserve for the future valuable environments that are essentially unmodified by man.

3. To provide research and educational opportunities for scientists and others in the observation, study, and monitoring of the environment.

4. To contribute to the national effort to preserve a full range of genetic and behavior diversity for native plants and animals, including endangered or threatened species.

The only routine management that will occur within these areas will be the removal of water impounded by beaver activity. It is possible that some unforseen event would require management in the area to fulfill the mission of the refuge and the Fish and Wildlife Service.

1. Site and Description

A unique area which contains 772 forested acres, and 38 acres of open water will be designated as a "No Management Zone." The site is located south of State Highway 87 and north of Hatchie River (see Exhibit 16), and it is the western most forest land on the refuge. This 772 acres constitutes 15% of the refuge's forest habitat. Society of American Forester's cover types in the area include 10 acres of the Cottonwood type, 14 acres of the Hackberry-American Elm-Ash type, 57 acres of the Baldcypress-Tupelo type, 121 acres of the Sweetgum-Willow Oak

type, 171 acres of the Overcup Oak-Water Hickory type and 397 acres of Water Tupelo-Swamp Tupelo type. Champion and Little Champion lakes are 33 and 8 acres respectively. In addition, a baldcypress slough runs from the Hatchie River up through the eastern side of the area. There are 3,550 MBF of sawtimber and 7,166 cords of pulpwood on the area.

2. Significance

This site represents a unique environment that is the least disturbed area on the refuge. Nearly half of the area is classified as Water Tupelo-Swamp Tupelo cover type. This is the only place on the refuge where this cover type is found. Except for baldcypress, the species of this cover type are of low commercial value. In addition, this is a very wet site which severely limits the opportunity for timber operations. Therefore, it is unlikely that this area has been logged recently.

Although logging activities in the proposed area have been minimal, public use has been high. Champion and Little Champion lakes are popular fishing areas. The clear open water lakes bordered by baldcypress are a significant visual resource. Immediately to the west of the site are the refuge's moist soils areas and agricultural lands. Designating this area as a "No Management Zone" will enhance the refuge's ability to meet the needs of wildlife and to preserve the remnant of undisturbed forest.

I. Special Management Considerations and Techniques

1. Green-tree reservoir management

Presently there are no man made GTRs within the refuge. However, seasonally flooded sloughs and intermediate flats create GTR conditions and provide over-wintering waterfowl habitat within the forested area. There are beaver impoundments which serve as natural GTRs that are drawn down during late spring and early summer by removing the dams.

2. Fire Management

Presently the only fire management activity occurring on the refuge is fire suppression. The Tennessee Division of Forestry, and the Service have a cooperative agreement in which the State is authorized to suppress any wildfire on the refuge.

The refuge staff is instructed via the Fire Management Plan to notify the state suppression agency immediately when fires are discovered on the refuge so suppression activities can be initiated.

3. Archeological and Cultural Resources Management

Archaeological resources are an irreplaceable part of the Nation's heritage, and therefore must be protected to prevent their loss and destruction. Public land managers are under legal obligation to protect these resources according to the Archaeological Resources Protection Act of 1979 (16 U.S.C. 470aa-470ee; 93 Stat. 721), the Antiquities Act of 1906 (16 U.S.C. 431-433; 34 Stat. 225), and other statutes.

It is possible that some disruption of an unknown archaeological site could occur in connection with forest management practices. Certain measures shall be taken, however, to help prevent any such occurrences. These actions include restriction of logging operations to dry weather to prevent soil disturbance and erosion; minimizing soil disturbance during construction of roads, trails, and firebreaks; and safeguarding any newly discovered archaeological sites or relics.

4. Aesthetics, etc.

Some habitat management treatments, however necessary to the achievement of management goals, may be viewed by some members of the general public as offensive. Some treatments impact the aesthetic qualities of the forest more than others, and different people look upon the results of these practices differently. "Aesthetic standards vary among men. Some will be disturbed by any harvest of mature timber, rejecting arguments that the trees are likely to blow down or to succumb to insects or disease within a few years in any event. Others will be less disturbed, or not disturbed at all, by the sight of the harvested area; they will find a newly established and thriftily growing forest aesthetically more pleasing than the old one, which in their eyes had passed its prime. Measurement of social and cultural acceptability is difficult, in part because of the variations among groups within the total society. Moreover, what is not acceptable today may become so tomorrow, and what is acceptable now may be rejected at some future date. But the forest manager who neglects social and cultural attitudes does so at his peril. Programs that are physically and biologically feasible and

economically sound may founder on public attitudes" (Clawson 1975).

These same silvicultural practices can also enhance the forest as a visual resource. "Foresters can manipulate stands of trees expressly to increase the enjoyment of persons passing through. A person may derive pleasure from the noticeable changes in spatial qualities as he moves from one stand to the next. The transitions from closure to openness, from darkness to brightness, from high canopy to low, evoke stimulating visual impressions. One extreme quality may act as a foil to intensify awareness of the opposite quality" (Brush 1976).

The impact on aesthetics will be considered in all forest management decisions, and sincere attempts shall be made to minimize any adverse impacts as much as practicable. Certain harvest methods can be selected for use over those more likely to evoke negative public reaction, but which accomplish essentially the same end results (McKnight and Johnson 1980, Marquis 1980). Particular attention will be given to those areas which receive relatively heavy public use, such as navigable waterways, public access roads, parking areas, boat-launch facilities, and interpretive trails. A three-chain (198 ft.) aesthetic zone bordering all the major waterways has been proposed, and stands within the zone will be managed to protect and enhance its scenic qualities, as well as to provide endangered species habitat.

5. Forest Openings Management

There is not sufficient need for permanent openings in the forest habitat. The refuge is long and narrow. The widest forested area is 2.5 miles and the narrowest is 0.4 miles. In addition, the refuge is surrounded by agricultural fields. The refuge represents a corridor of the bottomland forest environment in the middle of a landscape dominated by agriculture. The planned regeneration areas will provide temporary openings on a regular basis. Because of the size and shape of the refuge and the presence of regeneration openings, there are no plans to create permanent openings in the forest habitat.

J. Insect and Disease Control

Many hardwood stands, because of stress brought about by overstocked conditions, flooding, drought (Broadfoot and Toole 1958), over-maturity, fire, lightning, etc.

(Houston 1971), have been secondarily attacked by a variety of insect pests. Insects seldom kill hardwood trees, but they cause loss of growth and further decline in vigor and affect the merchantability of saw-logs. Among the most important trunk borers are the carpenterworm (Prionoxystus robiniae Peck), oak clearwing borer (Paranthrene simulans Grote), red oak borer (Enaphalodes rufulus Haldeman), and white oak borer (Goes tigrinus DeGeer) (Solomon 1978). Ambrosia beetles cause shothole, flagworm, and pinworm defects in oaks and hickories. The principal hardwood defoliator is the forest tent caterpillar (Malacosoma disstria Hubner) which attacks blackgum and sweetgum. Several other insects that defoliate hardwoods are the fall webworm (Hyphantria cunea), variable oakleaf caterpillar (Heterocampa manteo Doubleday), saddled prominent caterpillar (H. guttivitta), spiny oakworm (Anisota stigma Fabricius), and the walkingstick (Diapheromera femorata Say) (Abrahamson and McCracken 1971, Solomon et al. 1980, Morris 1955).

Numerous diseases in several different categories occur on hardwood trees. Canker rots, the most important of which are Polyporus hispidus (Bull.) Fr., Poria spiculosa Campb. & Davids, and Irpex mollis Leys ex Fr., appear on many species but are especially prominent in the red oak subgenus (McCracken 1978a and 1978b, Toole 1955 and 1957). Felling oaks infected with Polyporus hispidus may hinder the spread of the disease (McCracken and Toole 1974). Butt rot, the most serious cause of cull, affects all hardwood species (McCracken 1977, Solomon et al. 1980, Abrahamson and McCracken 1971). Many species of decay fungi are responsible for this type of damage. The most practical approach to control butt rot is prevention of injuries (fire, logging, etc.), since all infections occur through bark wounds. "It is the sprouts of lowest origin that are least likely later to contract rot from the decaying stump" (Roth and Hepting 1943a). Roth and Hepting later demonstrated that the incidence of butt rot can be predicted based on the height of sprout origin (Roth and Hepting 1969). Butt rot is also likely to appear in remaining stems when companion sprouts larger than 3 inches in diameter at the base are cut (Roth and Hepting 1943b). Little known is the fact that butt rot is commonly associated with increment borings in hardwoods (Lorenz 1944, Hepting, Roth, and Sleeth 1949, Toole and Gammage 1959); therefore, borings will be held to a minimum and made as near to the ground as practicable. Many of the same fungi which cause butt rot infect higher portions of trees, resulting in top rot (Toole 1961). Top rots are the principal means by which tree cavities utilized by wildlife are initiated. Other

types of disease, such as root rots, wilts, and cankers, as well as leaf and seeding diseases, chemical and pollution damage, and mistletoe infections affect hardwoods (Scharpf and Haeksworth 1974). Sweetgum blight, probably caused by soil moisture shortages, may be a factor on some sites (Toole 1959).

The only practical measure to control damage and loss from insects is to promote stand conditions favoring healthy and vigorous trees which are more resistant to infestation (Rexrode 1971). The goal is to maintain insect populations at suitable levels to provide an adequate supply for the various wildlife species which feed upon them, while at the same time hold habitat losses at acceptable levels.

K. Funds

Forest habitat management funds are programmed through the Migratory Bird Program. Expense for sales funds, programmed through activity 6800, are used only for actual timber harvest costs, such as salaries, equipment, and supplies.

Part III. PROGRAM DESCRIPTION, PROBLEMS, AND SOLUTIONS

A. Scope of Forest Program

The forest management program is designed to ~~strive to~~ enhance favored wildlife populations. ~~habitat requirements needed to achieve the refuge objectives.~~ This will be accomplished by identifying various habitats present on the refuge and deciding ~~what~~ which management practices ~~should be used to maintain these habitats or to improve any deficiencies which may occur.~~ to implement that would be most beneficial to wildlife.

B. Description

1. Acreage

Lower Hatchie is located on the North and South side of the Hatchie River in Tipton and Lauderdale Counties. The acres being considered in this plan are areas that have been purchased by the USFWS and some areas which are being purchased at the present time. Additional land may be purchased later and will have to be added to the plan. The refuge comprises 7536 acres. Of this acreage, the forested areas cover 5246 acres. Refer to Exhibit 12 for the location of refuge boundaries and to Exhibit 15 for spatial distribution of forested acreage.

2. Topography

Lower Hatchie is located within the Hatchie River bottom. The entire refuge is located within the Mississippi Alluvial Plain. Elevations range from 230' to 240' msl. Along the southern boundary there are some areas where elevation reaches 270' msl.

Management of bottomland hardwood species is dictated more by elevation than by any other single factor. A one foot change in elevation might make the difference in managing for overcup oak-bitter pecan type to sugarberry-American elm-green ash type. Elevation is very critical to bottomland species; it controls both moisture regime and site index. It is of great importance to recognize a so-called "ridge" in the bottomland areas. These ridges may be only a foot or two higher than the adjacent land. Also, it is important to note that a slight change in elevation often has a greater influence on the species composition, quality, growth, kinds of forage, etc. than a 1000 foot change may have in the mountains.

3. Drainage

All drainage from sloughs, lakes, and bayous flow into the Hatchie River. The Hatchie River is a class one scenic river, therefore has not been altered by man. The Mississippi River dictates the level and velocity of water within the Hatchie River. Therefore, when the Mississippi River is low the refuge drains rapidly, and when it is high the river overflows its banks easily.

4. Soils

Several soil types are found on Lower Hatchie NWR. Two major types are represented within the forested acreage, Amagon series and Sharkey Clay (See Soil Maps, Exhibit 13 and 14). See Exhibit 6 for soil characteristics and tree species tolerance chart. See Exhibit 7 for tree species shade and soil drainage tolerance chart.

a. Amagon Series - Within the Amagon series, there are 2 divisions; (1) Amagon silty clay loam, overwash, frequently flooded and (Am) (2) Amagon overwash and Oaklimeter silt loams, frequently flooded (AO).

Am soil is deep, nearly level, and poorly drained. It is found in low, flat areas and in long narrow depressions on the Mississippi flood plain. In most areas, this soil is subject to flooding each year in winter and spring. Many areas are flooded for several days.

AO soils are deep, nearly level, and poorly drained to moderately well drained. These soils are on the flood plain of the Hatchie River. Amagon overwash material is poorly drained and generally is in low, flat areas. Oaklimeter soil is moderately well drained and is on slightly higher ridges than Amagon soil or is on natural levees. These areas are subject to flooding by the Hatchie River from December through May in most years. Most areas are flooded at least once a year, and some areas are inundated for several weeks. Soil characteristics of the Amagon overwash and the Oaklimeter soils are similar. The major difference is that Amagon overwash is strongly acid to slightly acid in the surface layer and subsoil and is slightly acid or neutral in the substratum, and Oaklimeter is strongly acid or very strongly acid.

b. Sharkey Clay - This soil is deep, nearly level, and poorly drained. It is clayey deposits in broad, flat slack-water areas on the Mississippi River flood plain. This area is flooded by the Mississippi River, generally from January through May. Flooding duration is several days, but some areas are inundated for longer periods.

5. Problems

The major problem which will be encountered is the regeneration of the red oak component in order to maintain it as the major species within the forest stands. It is very clear that these species are having a difficult time competing in the shade of the closed canopies found throughout most of the forest. The shade tolerant species are taking over the stands and if something is not done to promote the shade intolerant red oaks, they will decrease in abundance within the future stands. Care must be taken to promote and identify areas containing red oak reproduction and to quickly release this reproduction. The goal is not to eradicate any given species. The remaining species will come into the stands without much effort.

6. Volumes

Refer to Tables 4-10 for a complete list of number of trees and volumes per acre by compartment, cover type, species, and inch-class. Refer to Table 3 for average 10-year diameter growth. The sawtimber volume per acre is increasing at 200 board feet per acre per year. Compartment summaries per acre are:

Compartment One

# Sawtimber Trees	35
Board Feet	8330
# Pulpwood Trees	100
Cords	3.9

Compartment Two

# Sawtimber Trees	30
Board Feet	8531
# Pulpwood Trees	53
Cords	2.3

Compartment Three	
# Sawtimber Trees	15
Board Feet	2283
# Pulpwood Trees	256
Cords	13.3
Compartment Five	
# Sawtimber Trees	23
Board Feet	7454
# Pulpwood Trees	61
Cords	2.6
Compartment Six	
# Sawtimber Trees	26
Board Feet	5163
# Pulpwood Trees	78
Cords	3.1
Compartment Seven	
# Sawtimber Trees	21
Board Feet	5329
# Pulpwood Trees	21
Cords	1.4
Compartment Eight	
# Sawtimber Trees	22
Board Feet	4599
# Pulpwood Trees	33
Cords	5.1

C. Program Effect on Local Economy

Public Law 96-285 states that the Secretary of the Interior shall give special consideration to the management of the timber on the refuge to insure continued commercial production and harvest compatible with the purposes for which the refuge is established and the needs of fish and wildlife which depend upon a dynamic and diversified hardwood forest.

The forest habitat management program will have a favorable effect on the local economy by providing jobs associated with timber harvesting and other management operations.

Part IV. PROGRAM UNITS-HABITAT MANAGEMENT COMPARTMENTS

A. General

The refuge has been separated into eight management compartments. Refer to Exhibit 18 for spatial distribution of these management units. Refer to Table 1 for acreage represented by forest cover type found in each compartment. Table 2 lists the acreage found in each compartment by cover type and stand density. Part III, section B-6 of this document gives compartment volume summaries. Refer to tables 4-10 for volume and trees per acre by compartment, cover type, species, and inch-class. Exhibits 19-24 shows distribution of cover types, stand size class, stand density, and other features found in each compartment.

The forest cover types found on the refuge are 91, 92, 93, 94, 96, 101, 102, 103. Silvicultural treatments outlined in Part I, section F-2 discusses various methods used and the conditions where they should be applied. Intermediate cuttings will be practiced throughout the refuge, in order to promote healthy, vigorous stands. TSI will be used where competition from non-favored species is such that other treatments cannot control their encroachment. Shelterwood will be used to promote reproduction and to release this reproduction. Clearcuts will be used to release advanced reproduction. The regeneration of stands will be done in areas where the timber is mature and decreasing in productivity and advanced reproduction is established. Timber types 91, 92, 96, and to some extent 93 and 94, lend themselves to shelterwood and clearcut methods due to the presence of favored species within the stands. These areas will be of highest priority and the majority of work will be done within these stands. Timber type 63 will be treated with intermediate cuttings and eventually may be converted to cover type 91, 92, or 96. This will be low priority unless the market for cottonwood becomes such that it would be beneficial to convert at an earlier date. Cover types 101 and 102 for the most part will not be harvested. The types of activities which may take place in these areas will be intermediate cuttings. There may be a need for thinning of dense cypress stands of younger trees, to maintain healthy growing conditions. In addition, sanitation cuts may be necessary if there are some pest infestations. Timber type 103 is located within the "No Management Zone". The management in this area is discussed in Part II, section H.

Areas exhibiting high reproduction densities as shown in Exhibit 17 will be given high priority. The areas

classified as A and B should be released, or prepared for release through shelterwood or intermediate cuts. The class C and D areas should be evaluated to see if silvicultural treatments could enhance the reproduction of favored species to be released at a later date.

Compartment prescriptions for each area entered will be written in accordance with the Refuge Manual. These guidelines are discussed in Part II, Section G of this document. At this time, specific attributes of the compartments will be discussed and management activities will be outlined.

B. Compartment Analysis

1. Compartment 1 and 2

Compartment one contains 685 acres, with 633 acres of timber and 52 acres of open land. Sawtimber comprises 527 acres and 70 percent of this is in cover type 92 and 96. Pulpwood acreage is 106 with cover type 96 making up 60 percent. Other cover types found in this compartment are 91, 93, 101, and 102. There are no areas classified as regeneration. Tables 4a-4z lists volume and number of trees per acre by cover type, species, and inch-class.

Compartment two contains 1101 acres, with 997 acres of timber, and 104 acres of open land. Sawtimber comprises 890 acres and 80 percent is in cover type 92 and 96. Pulpwood acreage is 107 with cover type 96 making up 58 percent. Other cover types in this compartment are 63, 93, 94, 101, 102. There are no areas in the regeneration class. Tables 5a-5ff lists volume and number of trees per acre by cover type, species, and inch-class.

The average age of the mature timber within these compartments ranges from 90-120 years old. The majority of these compartments contain mature timber. Beneath this timber is a high percentage of shade tolerant species. These compartments have areas of reproduction which need to be released or evaluated for silvicultural treatments to enhance reproduction (Exhibit 17). Compartment 1 contains some areas where there are some pulpwood size trees under the canopy of the older timber which could be released.

2. Compartment 3

Compartment three contains 1975 acres with 500 acres of timber, 91 acres of open water, and 1384 acres in agriculture and abandoned fields. Sawtimber comprises 89 acres and 88 percent is in cover type 92. Pulpwood acreage is 411 with cover type 103 making up 96 percent. There are no areas classified as regeneration. Tables 6a-6t lists volume and number of trees per acre by cover type, species and inch-class. This compartment is within the "No Management Zone" and management guidelines are outlined in Part II, section H of this document.

3. Compartment 4

Compartment four has 119 acres with no forested acreage. It consists mainly of old fields. Some of this area has been replanted. There will be an effort to reforest these abandoned fields, but it is a low priority activity.

4. Compartment 5

Compartment five contains 1108 acres with 970 acres of timber, four acres of open water, and 134 acres of open land. Sawtimber comprises 761 acres and 76 percent is in cover type 92 and 96. Pulpwood acreage is 194 with cover type 92 making up 52 percent. Other cover types within this compartment are 91, 93, 101, 102. Tables 7a-7bb lists volume and number of trees per acre by cover type, species, and inch-class. There are 15 acres of regeneration.

The average age of mature timber is 80-110 years old. This area is in the process of being purchased from Anderson Tully. Prior to purchase, some harvesting was done, but this area was not cut hard. Therefore, the majority of this compartment contains mature timber. Once again, the areas of high reproduction density outlined in Exhibit 17 should be addressed within the compartment prescription.

5. Compartment 6

Compartment six contains 1310 acres of timber and 13 acres of open water. Sawtimber comprises 566 acres and 75 percent is in cover type 92 and 96. Pulpwood acreage is 347 with cover type 92 and 93 making up 88 percent. Other cover types within this compartment are 101 and 102. Tables 8a-8x lists volume and number

of trees per acre by cover type, species, and inch-class. There is 397 acres of regeneration.

The average age of mature timber is 80-100 years old. This area is in the process of being purchased from Anderson Tully. Prior to purchase, some harvesting was done, and some areas were cut hard. The areas classified as regeneration on Exhibit 23 vary in intensity of harvest. Some of this resembles shelterwood cuts and some resembles partial clearcuts with a few scattered trees remaining. These sites will be evaluated for reproduction success and the remaining seed trees will be removed if they are inhibiting the growth of this reproduction. Also within this regeneration area there are 170 acres which were cleared in 1978 and has been abandoned since then. It is regenerating with a wide variety of species at this time. Management actions within areas showing reproduction density outlined in Exhibit 17 will be addressed within the compartment prescription.

6. Compartment 7

Compartment seven contains 380 acres of forest and 34 acres of agricultural land. Sawtimber comprises 360 acres, with cover type 92 making up 69 percent. Pulpwood comprises 20 acres and all of this is in cover type 92. Other cover types within this compartment are 93, and 96. Tables 9a-9j lists volume and number of trees by acre by cover type, species, and inch-class. Regeneration and age data were not taken for this compartment.

This compartment contains a high red oak component, and we will strive to maintain this component by promoting and releasing red oak regeneration. When this compartment is entered, detailed regeneration data will be taken to evaluate the need for various silvicultural practices.

7. Compartment 8

Compartment eight contains 455 acres of forest and 121 acres of open land and sand bars. Cover type 63 makes up 100 percent of this compartment. There are some areas with a high black willow component. Tables 10a-10d lists volume and number of trees by acre by cover type, species, and inch-class. Regeneration and age data were not taken for this compartment.

This area is sandy and contains a relatively young stand of pioneer species. Opportunities will be taken to introduce more favored species into this area. Intermediate cuttings will be used within these stands to promote healthy growing conditions.

C. Entry Cycle

The entry cycle will begin in 1993 and will cover compartments one, two, five, and six. These two years will be spent taking advantage of the reproduction located in the 1992 survey. These areas will be evaluated to take advantage of and promote advanced reproduction in order to regenerate some of these mature stands.

Beginning in 1995, compartment seven and eight will be entered. At this time the compartments will be evaluated to make management recommendations, if any are necessary, and prescriptions will be written outlining all recommended actions. The following compartments will be entered in the years listed:

COMPARTMENT	YEAR
1,2,5,6	1993
7,8	1995
6	1996
2	1997
3	1998
5	1999
4	2000
1	2001
6	2003

Part V. PHYSICAL PLANT AND EQUIPMENT USE REQUIREMENTS

A. Roads

Permanent roads do not exist on the forested areas of the refuge. However there are ATV trails that may be utilized. Compartments one, five, and six have access roads at the east and west ends with ATV trails running east and west through the compartments joining the roads. A road through compartments one, five and six would cover approximately six miles. Compartment two, north of Hatchie River does not have any permanent access. Presently this compartment is reached by crossing a private agricultural field with the permission of the landowner. This is not suitable for conducting forest or refuge management. Therefore, it is necessary to construct an access route on property owned by the refuge. In addition, 2 miles of road running the length of the compartment are needed. Compartments three, four, seven, and eight have adequate roads at this time. The proposed roads are needed to make the area accessible for timber harvest operations and to facilitate other refuge programs.

B. Miscellaneous Equipment

The refuge forester is currently using an 11-year-old, 2-wheel drive, Blazer that needs to be replaced by a 4X4, 1/2 ton pickup. Due to the lack of roads on the refuge an ATV will also be required. Computer hardware, software and supplies will also increase the effectiveness of the forestry staff.

Part VI. FUNDS AND MANPOWER

Lower Hatchie NWR is part of the Reelfoot Refuge Complex, and it is expected that 40 percent of the complex's forestry staff and resources will be required at Lower Hatchie Refuge. The anticipated funds and manpower requirements based on present value necessary to carry out the forest habitat management plan during this 10 year cutting cycle are:

1. Salaries	
1 Forester, GS-11	$154,000
1 Forester, GS-7	92,000
2. Operation Expenses	20,000
3. Equipment Replacement-2 pickup	30,000
4. Timber Stand Improvement	35,000
Total expenses for 10 year cutting cycle	$331,500

Part VII. PROGRAM DATA

A. Timber Cruise Information

A 2.5 percent inventory was conducted on compartments one, two, three, five, and six in August of 1992 to record information required to make informed decisions concerning the management of the forest habitat. Plots (1/5-acre circular) were taken on a 8 X 10 chain (1 chain = 66 feet) grid. Data taken at each plot were timber type, timber size and volume, age, growth, and den and snag tree abundance.

This would really be good information to present in a table.

Reproduction information was recorded from 1/100-acre plots at these same locations. Exhibit 8 is an example of a reproduction tally sheet used to record information. It is based on a model developed at the Southern Forest Experiment Station. Regeneration is tallied by size classes. Each size class is given a certain amount of points based on their expected survival. Therefore by looking at the total points for given species, the regeneration success can be predicted. This information was taken to develop Exhibit 17, which shows reproduction densities.

Exhibit 8 is Silviculture Decision Model Should be Exhibit 10.

Along with this information, comments were written down concerning some management alternatives for each area. This data was then tabulated using a forest inventory program. Individual tally sheets and detailed printouts are available for review at Reelfoot NWR headquarters. This information was condensed into tables 4-8. This data was also used to develop the timber type maps, Exhibits 19-22.

Compartments seven and eight were purchased after the initial cruise. Data for these areas was taken from a 1988 inventory done to evaluate these areas for purchase. Regeneration and age data were not obtained at this time. A 2.5% inventory using 1/5-acre circular plots was conducted. This information was entered into Omnitali to create tables 9-10.

B. Tables and Exhibits

Table 1. Acreage by SAF Cover Type by Compartment at Lower Hatchie National Wildlife Refuge.

COVER TYPE	1	2	3	5	6	7	8	TOTAL ACRES	PERCENT
63		49.7	9.8				454.9	514.4	9.8
91	2.5			7.1				9.6	0.2
92	123.6	279.7	79.4	477.3	756.6	269.5		1986.1	37.9
93	118.3	35.9	14.2	146.3	220.5	28.2		563.4	10.7
94		30.0						30.0	0.6
96	308.5	547.1		254.6	222.3	82.2		1414.7	27.0
101	49.3	29.8		75.4	31.6			186.1	3.5
102	31.2	25.4		9.4	79.4			145.4	2.8
103			397.0					397.0	7.6
TOTAL	633.4	997.6	500.4	970.1	1310.4	379.9	454.9	5246.7	
PERCENT	12.1	19.0	9.5	18.5	25.0	7.2	8.7		100.0

SUMMARY OF COVER TYPES

COVER TYPE #	COVER TYPES	%
63	Cottonwood	9.8
91	Swamp Chestnut Oak-Cherrybark Oak	0.2
92	Sweetgum-Nuttall Oak-Willow Oak	37.9
93	Hackberry-American Elm-Green Ash	10.7
94	Sycamore-Sweetgum-American Elm	0.6
96	Overcup Oak-Water Hickory	27.0
101	Baldcypress	3.5
102	Baldcypress-Tupelo	2.8
103	Water Tupelo-Swamp Tupelo	7.6

Table 2. Acres present in each compartment of SAF Cover Type, Timber Size Class, and Timber Density.

TIMBER TYPES	S-A	S-B	S-C	SAWTIMBER TOTAL	P-A	P-B	P-C	PULPWOOD TOTAL	R	COMPARTMENT TOTALS
COMPARTMENT 1										
91	2.5			2.5				0.0		2.5
92	66.5	57.1		123.6				0.0		123.6
93	12.2	48.2	32.7	93.1	25.2			25.2		118.3
96	180.8	35.4	27.6	243.8	64.7			64.7		308.5
101	10.5	22.2		32.7	16.6			16.6		49.3
102	22.7	8.5		31.2				0.0		31.2
TOTAL	295.2	171.4	60.3	526.9	106.5	0.0	0.0	106.5	0.0	633.4
COMPARTMENT 2										
63	32.7		17.0	49.7				0.0		49.7
92	174.8	49.5	17.9	242.2	25.8		11.7	37.5		279.7
93		35.9		35.9				0.0		35.9
94	8.5	7.5	14.0	30.0				0.0		30.0
96	320.8	126.3	35.1	482.2	64.9			64.9		547.1
101	29.8			29.8				0.0		29.8
102	20.0			20.0	5.4			5.4		25.4
TOTAL	586.6	219.2	84.0	889.8	96.1	0.0	11.7	107.8	0.0	997.6
COMPARTMENT 3										
63	9.8			9.8				0.0		9.8
92	79.4			79.4				0.0		79.4
93				0.0	14.2			14.2		14.2
103				0.0	397.0			397.0		397.0
TOTAL	89.2	0.0	0.0	89.2	411.2	0.0	0.0	411.2	0.0	500.4
COMPARTMENT 5										
91	2.5	4.6		7.1				0.0		7.1
92	238.2	138.8		377.0	16.0	84.3		100.3		477.3
93		65.4	20.2	85.6	29.2	22.3		51.5	9.2	146.3
96	74.4	115.4	16.6	206.4	13.7	29.0		42.7	5.5	254.6
101	53.1	16.7	5.6	75.4				0.0		75.4
102	9.4			9.4				0.0		9.4
TOTAL	377.6	340.9	42.4	760.9	58.9	135.6	0.0	194.5	14.7	970.1

Table 2. Continued.

TIMBER TYPES	S-A	S-B	S-C	SAWTIMBER TOTAL	P-A	P-B	P-C	PULPWOOD TOTAL	R	COMPARTMENT TOTALS
COMPARTMENT 6										
92	144.1	137.3	16.9	298.3		161.6		161.6	296.7	756.6
93	32.8	21.7	22.7	77.2	41.8	101.5		143.3		220.5
96	20.5	78.3	29.0	127.8		14.3		14.3	80.2	222.3
101	5.0	26.6		31.6				0.0		31.6
102	13.9	17.0		30.9		27.8		27.8	20.7	79.4
TOTAL	216.3	280.9	68.6	565.8	41.8	305.2	0.0	347.0	397.6	1310.4
COMPARTMENT 7										
92	249.1			249.1			20.4	20.4		269.5
93	10.9		17.3	28.2				0.0		28.2
96	82.2			82.2				0.0		82.2
TOTAL	342.2	0.0	17.3	359.5	0.0	0.0	20.4	20.4	0.0	379.9
COMPARTMENT 8										
63	115.3	137.8	92.6	345.7		22.9	86.3	109.2		454.9
TOTAL	115.3	137.8	92.6	345.7	0.0	22.9	86.3	109.2	0.0	454.9
	S-A	S-B	S-C	SAW TOTAL	P-A	P-B	P-C	PULP TOTAL	R TOTAL	
REFUGE TOTALS	2022.4	1150.2	365.2	3537.8	714.5	463.7	118.4	1296.6	412.3	5246.7

Table 3. Average 10-year Diameter Growth Rates.

SPECIES	Growth (DBH)
Cherrybark Oak	2.62
Nuttall Oak	2.63
Willow Oak	3.14
Pin Oak	2.95
Water Oak *	3.20
Overcup Oak	2.05
Sweetgum 2.83	
Hickory	2.32
Bitter Pecan	1.94
Black Willow	3.20
Tupelo	3.30
Locust	2.72
River Birch	2.13
Hackberry	2.64
American Elm	2.56
Ash	2.34
Sycamore 4.49	
Maple 3.16	
Cottonwood	3.20
Persimmon	2.26
Mulberry 2.00	
Boxelder 2.00	
Water Elm	2.20

* Explain why these are offset!